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(54) **A connector**

(57) An object of the present invention is to provide a circuit board connector having an improved durability against forces acting on a housing to separate the housing from a circuit board.

Engaging portions 24 are so bent as to increase the areas of engaging surfaces 25 in the thickness direction TD thereof. Since contact areas of the engaging portions 24 and restricting surfaces 14 increase in this way, forces

acting on the contact surfaces are distributed to become smaller. Accordingly, even if large separating forces repeatedly act on a housing 10, the damage and the like of the engaging portions 24 and restricting surfaces 14 can be presented, with the result that durability against the separating forces can be improved. Further, according to the present invention, an improvement in the durability of this circuit board connector 1 is realized without enlarging the housing 10.

FIG. 5A

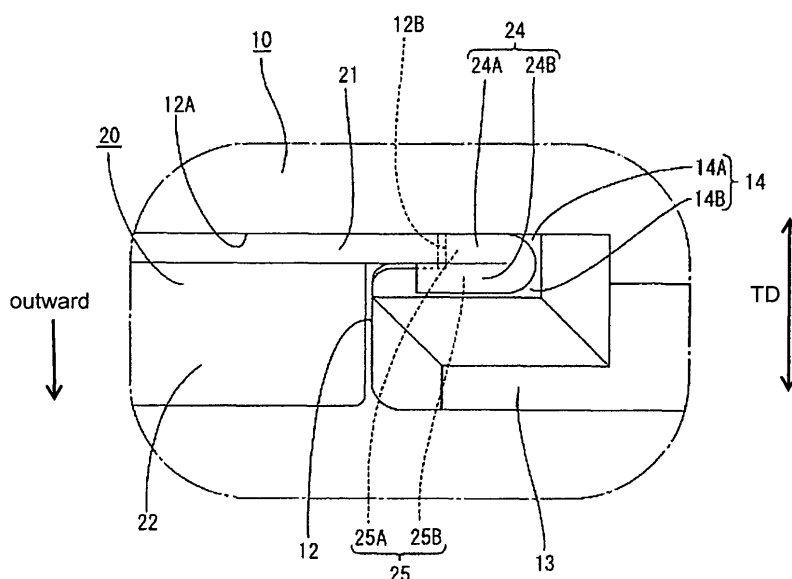
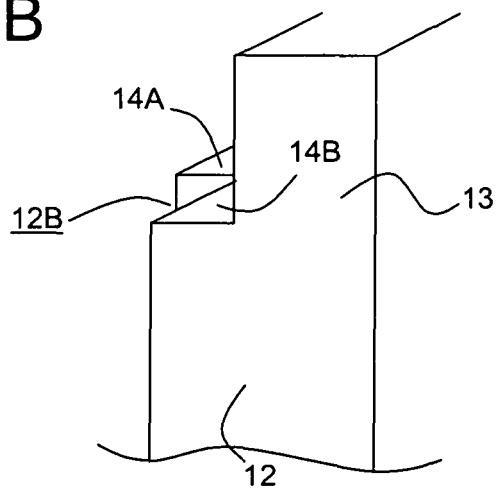


FIG. 5B



Description

[0001] The present invention relates to a connector to be mounted on a device, particularly to a circuit board connector.

[0002] A conventional circuit board connector is known from Japanese Unexamined Patent Publication No. 2005-166492. This circuit board connector includes a housing which is fixed to one surface of a circuit board and into which a mating connector is fittable from front. Fixing brackets separate from the housing and made of a metal plate are mounted in this housing, and the circuit board connector is fixed to the circuit board by placing the circuit board connector on the circuit board and soldering the bottom ends of the fixing brackets to the circuit board.

[0003] The fixing brackets are inserted from above into mount grooves formed in the opposite side surfaces of the housing and mounted such that the plate surfaces thereof extend along the side surfaces of the housing. The width of upper end portions of the fixing brackets in forward and backward directions is set larger than the width of lower parts of the fixing brackets, and restricting surfaces that can come into contact with the bottom edges of parts (engaging portions) of the upper end portions of the fixing brackets bulging out forward and backward are formed in the mount grooves. By the contact of the engaging portions with the restricting surfaces, the fixing brackets are mounted in the mount grooves with downward displacements thereof relative to the housing restricted.

[0004] The circuit board connector is used with the mating connector connected therewith. Thus, if a wiring harness drawn out from the mating connector is, for example, shaken upward and downward during the use of the circuit board connector, forces resulting from such upward and downward shaking movements are transmitted to the housing of the circuit board connector via the mating connector. In other words, a force (upward acting force) to separate the housing from the circuit board repeatedly acts on the housing. Accordingly, in order to improve the durability of the circuit board connector, it is essential to improve durability against the separating forces.

[0005] In the construction described above, if the separating force acts on the housing, the restricting surfaces of the housing and the engaging portions of the fixing brackets come into contact with each other, whereby large forces repeatedly act on the contact surfaces. Here, since the parts of the engaging portions in contact with the restricting surfaces are bottom edges of plate members, contact areas between the engaging portions and the restricting surfaces are not very large. Thus, large stresses are generated on the contact surfaces by the contact of the engaging portions and the restricting surfaces. Accordingly, in order to realize a circuit board connector capable of enduring the use under a severe environment such as vibration over a long time, it is necessary

to prevent the engaging portions and restricting surfaces from being damaged or broken even if the separating forces repeatedly act on the housing.

[0006] The present invention was developed in view of the above situation, and an object thereof is to provide a connector to be mounted to or on a device having an improved durability against forces acting on a housing to separate the housing from the device.

[0007] This object is solved according to the invention by the features of the independent claim. Preferred embodiments of the invention are subject of the dependent claims.

[0008] According to the invention, there is provided a connector to be connected to a device such as a circuit board, comprising:

a housing with which a mating connector is connectable,
at least one fixing member made of a metallic plate material, at least partly mountable into at least one respective mount groove formed in the housing, and having a bottom end portion to be fixed to a device such as a circuit board,
at least one engaging portion formed on the fixing member, and
at least one restricting surface provided in the mount groove and adapted to restrict a displacement in an insertion direction of the engaging portion by coming into contact with the bottom end of the engaging portion along the insertion direction,

wherein the engaging portion is so bent or folded or shaped as to increase the area at least of the bottom end thereof in the thickness direction thereof.

[0009] The engaging portion is so bent or folded or shaped as to increase the area of the bottom end thereof in the thickness direction thereof. Since the contact area of the engaging portion and the restricting surface is increased by this, a force acting on the contact surface is substantially distributed to become smaller. Accordingly, even if large separating forces repeatedly act on the housing, the damage and the like of the engaging portion and the restricting surface can be presented, with the result that durability against separating forces can be improved.

[0010] Here, if the area of the bottom end is increased in the direction of the plate surface of the engaging portion (direction along the side surface of the housing) by increasing the projecting distance of the engaging portion instead of bending the engaging portion, the side surface of the housing needs to be enlarged, i.e. the housing needs to be enlarged in forward and backward directions. However, according to the above construction, the area of the bottom end is increased in the thickness direction of the engaging portion by bending or folding the engaging portion, wherefore the housing needs not be enlarged in forward and backward directions. Accordingly, the contact area of the engaging portion and restricting surface

can be increased and the durability of the circuit board connector can be improved without enlarging the housing.

[0011] According to a preferred embodiment of the invention, the at least one respective mount groove is formed in a side surface of the housing such that the plate surface thereof extends substantially along the side surface of the housing.

[0012] Preferably, at least one engaging portion formed on the fixing member and having a plate surface projecting along the side surface of the housing at least from one of the front and rear edges of the fixing member.

[0013] Further preferably, at least one solder portion projecting in a direction at an angle different from 0° or 180°, preferably substantially normal to the side surface of the housing is provided at the bottom end of the fixing member.

[0014] Most preferably, the fixing member is fixed to the device preferably by soldering or welding the solder portion to the outer surface of the device.

[0015] According to a further preferred embodiment of the invention, the engaging portion is bent at a projecting end position thereof toward a projecting side of the fixing member, preferably of the solder portion, with at least one bent part thereof located more inward than the position of the projecting end of the fixing member, preferably of the solder portion.

[0016] Preferably, the engaging portion is folded back such that two parts substantially are in surface contact with each other.

[0017] Further preferably, the engaging portion is bent so as to be substantially L-, V or U-shaped.

[0018] Still further preferably, at least one part arranged deeper in the inserting direction as the restricting surface serve as at least one narrowing portion for narrowing the width of the respective mount grooves preferably in forward and backward directions.

[0019] Most preferably, when the fixing bracket is at least partly inserted into the mount grooves, one or more retaining portions of the fixing bracket gradually bite in the narrowing portions and the fixing bracket is held retained in the housing.

[0020] According to a further preferred embodiment of the invention, there is provided a circuit board connector, comprising:

a housing with which a mating connector is connectable from front,

a fixing member made of a metallic plate material, mountable into a mount groove formed in a side surface of the housing such that the plate surface thereof extends along the side surface of the housing, and having a bottom end portion to be fixed to a circuit board,

an engaging portion formed on the fixing member and having a plate surface projecting along the side surface of the housing at least from one of the front and rear edges of the fixing member, and

a restricting surface provided in the mount groove and adapted to restrict a downward displacement of the engaging portion by coming into contact with the bottom end of the engaging portion from below,

wherein the engaging portion is so bent as to increase the area of the bottom end thereof in the thickness direction thereof.

[0021] The engaging portion is so bent as to increase the area of the bottom end thereof in the thickness direction thereof. Since the contact area of the engaging portion and the restricting surface is increased by this, a force acting on the contact surface is distributed to become smaller. Accordingly, even if large separating forces repeatedly act on the housing, the damage and the like of the engaging portion and the restricting surface can be presented, with the result that durability against separating forces can be improved.

[0022] Here, if the area of the bottom end is increased in the direction of the plate surface of the engaging portion (direction along the side surface of the housing) by increasing the projecting distance of the engaging portion instead of bending the engaging portion, the side surface of the housing needs to be enlarged, i.e. the housing needs to be enlarged in forward and backward directions. However, according to the above construction, the area of the bottom end is increased in the thickness direction of the engaging portion by bending the engaging portion, wherefore the housing needs not be enlarged in forward and backward directions. Accordingly, the contact area of the engaging portion and restricting surface can be increased and the durability of the circuit board connector can be improved without enlarging the housing.

[0023] Preferably, a solder portion projecting in a direction normal to the side surface of the housing is provided at the bottom end of the fixing member, the fixing member is fixed to the circuit board by soldering the solder portion to the outer surface of the circuit board, and

the engaging portion is bent at a projecting end position thereof toward a projecting side of the solder portion with a bent part thereof located more inward than the position of the projecting end of the solder portion.

[0024] Since the engaging portion is bent at the projecting end position thereof toward the projecting side of the solder portion and the bent part is located more inward than the projecting end position of the solder portion, the thickness (dimension in a direction normal to the side surface of the housing) of the entire fixing member can be suppressed to that of a fixing member in which an engaging portion is not bent. This can maximally suppress the lateral enlargement of the circuit board connector.

[0025] Most preferably, the engaging portion is folded back such that two parts adhere to each other.

[0026] Since the engaging portion is folded back such that the two parts adhere to each other, the area of the restricting surface can be made smaller as compared to

the case where there is a clearance between the two parts while ensuring the same contact area of the engaging portion and restricting surface. Therefore, the space efficiency of the housing is better.

[0027] These and other objects, features and advantages of the present invention will become more apparent upon reading of the following detailed description of preferred embodiments and accompanying drawings. It should be understood that even though embodiments are separately described, single features thereof may be combined to additional embodiments.

FIG. 1 is a plan view of a circuit board connector according to a first embodiment,
 FIG. 2 is a side view of the circuit board connector,
 FIG. 3 is a side view in section of the circuit board connector showing a state where a fixing bracket is mounted in a mount groove,
 FIG. 4 is a perspective view showing the external configuration of the fixing bracket,
 FIG. 5A is an enlarged view within a dashed-dotted line of FIG. 1 and FIG. 5B is an enlarged perspective view thereof,
 FIG. 6 is a partial enlarged plan view of a fixing bracket showing the shape of an engaging portion according to a second embodiment,
 FIG. 7 is a partial enlarged plan view of a fixing bracket showing the shape of an engaging portion according to a third embodiment, and
 FIG. 8 is a partial enlarged plan view of a fixing bracket showing the shape of an engaging portion according to a fourth embodiment.

<First Embodiment>

[0028] Hereinafter, a first preferred embodiment of the present invention is described with reference to FIGS. 1 to 5.

[0029] A circuit board connector 1 of this embodiment is fixed or fixable or mountable to the upper surface (front surface) of an electric or electronic device such as a circuit board K, and an unillustrated mating connector is at least partly fittable thereto from front (right side in FIG. 1).

[0030] The circuit board connector 1 includes a housing 10 e.g. made of a synthetic resin (preferably a highly heat resistant synthetic resin) and preferably substantially having a laterally long block shape as a whole. A front part of the housing 10 serves as a receptacle 10A (preferably substantially in the form of a rectangular tube) into which the mating connector is at least partly fittable or insertable. When the mating connector is at least partly fitted or inserted into this receptacle 10A, the mating connector and the housing 10 are held properly connected by unillustrated locking means.

[0031] This housing 10 includes one or more, preferably a plurality of terminals 11. Each of the plurality of terminals 11 is held such that one end portion thereof

projects into the receptacle 10A and the other end portion thereof projects backward from the rear surface of the housing 10. The one end portion of each terminal 11 projecting into the receptacle 10A is connectable with a mating terminal (not shown) held in the mating connector, and the other end portion thereof is bent at an angle different from 0° or 180°, preferably substantially normal or down after extending backward from the housing 10 and the bottom end thereof serves as a connecting portion 11A to be connected (preferably soldered or welded or press-fitted) to a conductor path (not shown) on the upper surface of the device, preferably the circuit board K (see FIG. 3).

[0032] As shown in FIG. 1, one or more mount grooves 12 into which one or more fixing brackets 20 (corresponding to a preferred fixing bracket) to be described later are mountable are formed in the (preferably substantially opposite) lateral (left and/or right) surface(s) of the housing 10. The lateral (left and/or right) mount groove(s) 12 is/are formed by recessing the lateral (left and/or right) surface(s) of the housing 10 inward in areas from positions near the front end(s) to position(s) near the back end(s), and make openings preferably in both upper and lower surfaces of the housing 10. The fixing brackets 20 are at least partly insertable into the mount grooves 12 in an insertion direction ID, preferably substantially from above. It should be noted that the mount grooves 12 are described in detail after the shape of the fitting brackets 20 is described.

[0033] The fixing brackets 20 are for fixing the housing 10 onto the device such as the circuit board K, and preferably are formed by punching or cutting a metal plate material out into a specified (predetermined or predetermined) shape and bending, folding and/or embossing the punched-out or cut-out material.

[0034] Each fixing bracket 20 is comprised of a main body 21 to be arranged substantially along a back surface 12A (surface at the back side of a recess formed in the side surface of the housing 10) of the mount groove 12, and a fixing portion (preferably comprising a solder portion 22) bulging out sideways (in a direction at an angle different from 0° or 180°, preferably substantially normal to the side surface of the housing 10) from the lateral (bottom) end of the main body 12, and preferably the cross-sectional shape thereof in forward and backward directions FBD is substantially L-shaped or bent.

[0035] As shown in FIGS. 2 and 3, the main body 21 is in the form of a flat plate preferably having substantially the same width as the width of the back surface 12A of the mount groove 12 in forward and backward directions FBD and having a substantially rectangular shape slightly longer in forward and backward directions FBD. This main body 21 is to be closely mounted in the mount groove 12 such that almost no clearance is defined between the inner side surface thereof (surface at a side opposite to the side where the solder portion 22 projects) and the back surface 12A of the mount groove 12.

[0036] The fixing or solder portion 22 is so bent at the

distal or bottom end position of the main body 21 as to extend in a direction at an angle different from 0° or 180°, preferably substantially normal to the plate surface of the main body 21. When the circuit board connector 1 is placed on the respective (upper) surface of the device particularly of the circuit board K, the plate surface (lower surface) of the solder portions 22 are substantially opposed to the respective (upper) surface of the device (circuit board K). By fixing the fixing portion, preferably by soldering the solder portions 22, the circuit board connector 1 is placed and fixed on the outer surface of the device (circuit board K). The solder portions 22 preferably have a substantially rectangular shape having a width necessary to solder and fix, and extend from the front ends to the rear ends of the bottom ends of the main bodies 21 (see FIG. 4).

[0037] As shown in FIG. 3, one or more (preferably a pair of front and/or rear) retaining portions 23 substantially projecting forward and backward are formed at one or more vertically intermediate positions (preferably at substantially vertically middle positions) of the front and/or rear edges of the main body 21. The retaining portion(s) 23 bite(s) in one or more narrowing portions 15 of the mount groove(s) 12 as the one or more fixing brackets 20 are mounted into the respective mount grooves 12, thereby retaining the fixing bracket(s) 20 in the mount groove(s) 12.

[0038] One or more (preferably a pair of front and/or rear) engaging portions 24 are provided at or near the upper end of the main body 21. The respective engaging portions 24 preferably have substantially rectangular shapes and substantially project forward and backward from the front and/or rear edges of the main body 21, and are bent or substantially folded back at their projecting end portions as shown in FIG. 4. Each engaging portion 24 is comprised of a part up to the projecting position (hereinafter, "projecting portion") and a part folded back or bent at or near the projecting end position (hereinafter, "folded portion 24B").

[0039] Each folded portion 24B is substantially folded back or bent at or near the projecting end position at the same side toward which the corresponding fixing or solder portion 22 is bent. Preferably, the plate surface of each projecting portion 24A and that of the folded portion 24B substantially closely adhere to each other or contact each other. In other words, the plate surface of each projecting portion 24A and that of the folded portion 24B preferably come into a surface contact with each other preferably over more than about 80%, more preferably over more than about 90%, most preferably over more than about 95% of their respective surface. The leading ends of the folded portions 24B (ends at sides opposite to the bent sides) reach positions more inward than the front and rear edges of the main body 21. Thus, the engaging portions 24 preferably have a thickness that is about twice the thickness of the metal plate material over the substantially entire width in the projecting direction. Therefore, the engaging portions 24 are thickened out-

ward (projecting sides of the solder portions 22) as compared to the other part of the main body 21.

[0040] The bottom ends of the engaging portions 24 serve as engaging surfaces 25 that can come substantially into contact with restricting surfaces 14 of the mount grooves 12 to be described. Each engaging surface 25 is a sum or a combination of the bottom end surface (hereinafter, "inner engaging surface 25A") of the projecting portion 24A and the bottom end surface (hereinafter, "outer engaging surface 25B") of the folded portion 24B. The engaging surfaces 25 preferably are surfaces substantially parallel to the outer surface of the device (circuit board K) with the housing 10 placed on the outer surface of the device (circuit board K). When viewed from below, the engaging surfaces 25 preferably are widened outward by as much as the outer engaging surfaces 25B as compared to the other parts of the main bodies 21.

[0041] The entire thickness (dimension normal to the side surfaces of the housing 10) of each fixing bracket 20 is a sum or a combination of the thickness of the main body 21 and a dimension of the fixing or solder portion 22 from the plate surface of the main body 21 to the projecting end position.

[0042] The mount grooves 12 are recessed parts with a depth substantially equal to the entire thickness of the fixing brackets 20. As shown in FIG. 1, the front and rear end surfaces of each groove 12 are formed with a pair of facing walls 13 projecting backward and forward from these front and rear end surfaces while facing the back surface 12A of each mount groove 12. These facing walls 13 preferably are arranged substantially along the front and rear end edges of each mount groove 12. Clearances substantially equal to or slightly larger than the thickness of the main body 21 of the fixing bracket 20 are defined between the back surface 12A of the mount groove 12 and the inner surface (surface facing the back surface 12A) of the facing walls 13.

[0043] At the front and rear ends of each mount groove 12, one or more insertion grooves 12B having the front and rear end surfaces as bottom surfaces, and the back surface 12A and facing walls 13 as side surfaces are formed. The insertion grooves 12B substantially vertically extend along the front and/or rear end edges of the mount groove 12, and the front and rear end edges of the main body 21 are at least partly inserted into the insertion grooves 12B, whereby the fixing brackets 20 are so held as not to come out sideways from the mount grooves 12.

[0044] As shown in FIGS. 2 and 3, the restricting surfaces 14 extending in a direction (intersecting with an inserting direction ID of the fixing brackets 20) at an angle different from 0° or 180°, preferably substantially normal to the bottom surfaces of the insertion grooves 12B formed at the front and/or rear sides are formed at positions of the bottom surfaces of the insertion grooves 12B near the upper ends.

[0045] The restricting surfaces 14 preferably are substantially parallel to the upper surface of the device (cir-

cuit board K) with the housing 10 placed on the upper surface of the device (circuit board K). As shown in FIG. 5, the restricting surfaces 14 are shaped to extend from parts formed in the insertion grooves 12B to the inner parts of the facing walls 13. Hereinafter, the parts formed in the insertion grooves 12B are referred to as inner restricting surfaces 14A, and parts formed on the facing walls 13 as outer restricting surfaces 14B. Thus, the inner surfaces of the facing walls 13 have upper parts thereof recessed more outward than the outer restricting surfaces 14B (as can be seen in particular in FIG. 5).

[0046] The width of the inner restricting surfaces 14A in inward and outward directions preferably is substantially equal to the width of the insertion grooves 12B, and the width of the outer restricting surfaces 14B in inward and outward directions preferably is substantially equal to the width of the inner restricting surfaces 14A. The width in inward and outward directions of each restricting surfaces 14A, 14B preferably is slightly larger than twice the thickness of the fixing brackets 20. When the restricting surfaces 14 are viewed from above, the outer restricting surfaces 14B project more forward or backward than the inner restricting surfaces 14A. Since the outer restricting surfaces 14B are formed on upper end portions of the facing walls 13 (or on distal sides of the facing walls 13), the restricting surfaces 14 can laterally expand without laterally enlarging the housing 10.

[0047] When the fixing brackets 20 are at least partly inserted into the respective mount grooves 12, the engaging surfaces 25 of the engaging portions 24 come substantially into contact with the restricting surfaces 14 of the respective mount grooves 12 to position the fixing brackets 20 along the inserting direction ID (or substantially in vertical direction). More specifically, the inner engaging surfaces 25B of the engaging surfaces 25 come substantially into contact with the inner restricting surfaces 14A and the outer engaging surfaces 25B come substantially into contact with the outer restricting surface 14B. Since a dimension of the outer restricting surfaces 14B in forward and backward directions FBD is larger than that of the outer engaging surfaces 25B in forward and backward directions FBD as shown in FIG. 5, the entire outer engaging surfaces 25B come substantially into contact with the outer restricting surfaces 14B.

[0048] As shown in FIG. 3, parts below (or arranged deeper in the inserting direction ID as) the restricting surfaces 14 serve as the narrowing portions 15 for (preferably gradually) narrowing the width of the respective mount grooves 12 in forward and backward directions FBD. When the fixing brackets 20 are at least partly inserted into the mount grooves 12, the retaining portions 23 gradually bite in the narrowing portions 15 and the fixing brackets 20 are held retained at a specified (predetermined or predeterminable) height in the housing 10, more specifically held retained in the lateral (left and/or right) mount grooves 12 at such positions where the lower surfaces thereof (lower surfaces of the solder portions

22) are located slightly below the bottom surface of the housing 10. At this time, the solder portions 22 of the fixing brackets 20 are at least partly accommodated in the mount grooves 12 substantially without laterally projecting from the side surfaces of the housing 10.

[0049] Next, functions and effects of the first embodiment constructed as above are described.

[0050] First, the circuit board connector 1 is fixed to the mounting surface (upper surface) of the device (preferably the circuit board K). Cream solder preferably is applied to lands (not shown) on the mounting (upper) surface of the device (circuit board K) beforehand, and the housing 10 is placed on the device (circuit board K) with the connecting portions 11A of the terminals 11 and the fixing or solder portions 22 of the fixing brackets 20 substantially positioned on the corresponding lands. When the device (circuit board K) bearing the housing 10 is transported in a reflow furnace (not shown), the cream solder melts to adhere to the connecting portions 11A of the terminals 11 and the solder portions 22 of the fixing brackets 20. When the solder is solidified, the connecting portions 11A of the terminals 11 are electrically connected with the conductor paths of the device (circuit board K) and the solder portions 22 of the fixing brackets 20 are fixed to the device (circuit board K), whereby the circuit board connector 1 is fixed to the device (circuit board K).

[0051] The mating connector is connected with the circuit board connector 1 fixed on the device (circuit board K) in this way, and the connected connectors are used by being installed in a vehicle, an electric appliance or the like. Then, a wiring harness drawn out from the mating connector moves upward and downward e.g. as the vehicle or the like vibrates, and forces resulting from the upward and downward movements are transmitted to the housing 10 of the circuit board connector 1 via the mating connector. Thus, upward (direction to separate the circuit board connector 1) forces may repeatedly act on the housing 10 as the wiring harness moves upward and downward.

[0052] Every time the upward force acts on the housing 10, the restricting surfaces 14 of the mount grooves 12 are pressed against the engaging surfaces 25 of the engaging portions 24. Here, according to the construction of this embodiment, since the engaging portions 24 are bent or substantially folded back, the contact areas of the restricting surfaces 14 and engaging surfaces 25 are increased by as much as the outer engaging surfaces 25B as compared to conventional engaging portions having no folded portions 24B. The contact areas preferably are substantially twice as much as in the case where there are no folded portions 24B. If the same forces act on the contact surfaces, a pressing force per unit area of the contact surface is reduced to about half. As a result, stresses generated on the contact surfaces become smaller. Therefore, even under a severe environment e.g. where the wiring harness vibrates very much, the damage or the like of the engaging portions 24 and the

restricting surfaces 14 can be prevented, with the result that durability against the separating forces can be improved.

[0053] If an attempt is made to ensure the same contact areas as in this embodiment without bending the engaging portions 24, the projecting distance of the engaging portions 24 needs to be increased by as much as the dimension of the folded portions 24B in forward and backward directions FBD. Then, the dimension of the entire fixing brackets 20 in forward and backward directions FBD increases to twice the dimension of the folded portions 24B in forward and backward directions FBD since the projecting distance of the engaging portions 24 are increased at both front and rear sides. This makes it necessary to expand the restricting surfaces 14 in forward and backward directions FBD by as much as the dimension of the folded portions 24B in forward and backward directions FBD, leading to the enlargement of the housing 10 in forward and backward directions FBD. However, since the engaging portions 24 are bent or substantially folded in this embodiment, the housing 10 needs not be enlarged in forward and backward directions FBD. In the case of strictly restricting a space to arrange the circuit board connector 1 for the high-density mounting of the device (circuit board K), the smaller width of the housing 10 in forward and backward directions FBD is particularly advantageous.

[0054] The folded portions 24B of the engaging portions 24 preferably are substantially folded back toward the side of the solder portions 22 and the thickness (dimension normal to the side surfaces of the housing 10) of the fixing brackets 20 preferably are the substantially same as in the case where there are no folded portions 24B. This can prevent the circuit board connector 1 from being laterally enlarged.

[0055] In addition, since the folded portions 24B and the projecting portions 24A preferably substantially closely adhere or contact to each other substantially without defining any clearance therebetween, the area of the restricting surfaces 14 can be more decreased as compared to the case where there is a clearance while ensuring the substantially same contact areas of the engaging surfaces 25 and the restricting surfaces 14. Thus, the extended parts (outer restricting surfaces 14B) of the restricting surfaces 14 can be so dimensioned as to be formed on the upper parts of the facing walls 13, with the result that the width of the housing 10 in lateral direction (or in a direction at an angle different from 0° or 180°, preferably substantially normal to the forward and backward directions FBD) is the substantially same as the conventional one (in which the areas of the engaging surfaces are not expanded). Therefore, in this embodiment, the durability of the circuit board connector 1 is improved while the size of the circuit board connector 1 is suppressed to that of the conventional circuit board connector.

[0056] As described above, according to the first embodiment, the engaging portions 24 are bent or substan-

tially folded so that the areas of the engaging surfaces 25 increase in the thickness direction TD of the engaging portions 24. Since the contact areas of the engaging portions 24 and restricting surfaces 14 are increased by this, forces acting on the contact surfaces are substantially distributed to become smaller. Accordingly, even if large separating forces repeatedly act on the housing 10, the damage and the like of the engaging portions 24 and restricting surfaces 14 can be presented, with the result that durability against the separating forces can be improved. Further, according to this embodiment, an improvement in the durability of this circuit board connector 1 is realized without enlarging the housing 10.

[0057] Accordingly, to provide a circuit board connector having an improved durability against forces acting on a housing to separate the housing from a circuit board, one or more engaging portions 24 are so bent or folded as to increase the areas of engaging surfaces 25 in the thickness direction TD thereof. Since contact areas of the engaging portions 24 and restricting surfaces 14 increase in this way, forces acting on the contact surfaces are distributed to become smaller. Accordingly, even if large separating forces repeatedly act on a housing 10, the damage and the like of the engaging portions 24 and restricting surfaces 14 can be presented, with the result that durability against the separating forces can be improved. Further, according to the present invention, an improvement in the durability of this circuit board connector 1 is realized without enlarging the housing 10.

<Second Embodiment>

[0058] Next, a second preferred embodiment of the present invention is described with reference to FIG. 6.

[0059] This embodiment differs from the first embodiment in the shape of each engaging portion 30 in which a projecting portion 30A and a folded portion 30B do not adhere to or contact each other. This engaging portion 30 is substantially L-shaped by the projecting portion 30A and the folded portion 30B. The folded portion 30B projects up to a position more inward than the position of a projecting end 31A of a solder portion 31, and the entire thickness of a fixing bracket 32 is suppressed to that of a fixing bracket in which an engaging portion is not bent.

<Third Embodiment>

[0060] Next, a third preferred embodiment of the present invention is described with reference to FIG. 7.

[0061] This embodiment differs from the first embodiment in the shape of each engaging portion 40 in which a projecting portion 40A and a folded portion 40B do not adhere to or contact each other. This engaging portion 40 is substantially U-shaped or bent by the projecting portion 40A and the folded portion 40B. The folded portion 40B projects up to a position more inward than the position of a projecting end 41A of a solder portion 41,

and the entire thickness of a fixing bracket 42 is suppressed to that of a fixing bracket in which an engaging portion is not bent.

<Fourth Embodiment>

[0062] Next, a fourth preferred embodiment of the present invention is described with reference to FIG. 8.

[0063] This embodiment differs from the first embodiment in the shape of each engaging portion 50 in which a projecting portion 50A and a folded portion 50B do not adhere to or contact each other. This engaging portion 50 is substantially V-shaped by the projecting portion 50A and the folded portion 50B. The folded portion 50B projects up to a position more inward than the position of a projecting end 51A of a solder portion 51, and the entire thickness of a fixing bracket 52 is suppressed to that of a fixing bracket in which an engaging portion is not bent.

<Other embodiments>

[0064] The present invention is not limited to the above described and illustrated embodiments. For example, the following embodiments are also embraced by the technical scope of the present invention as defined by the claims.

(1) Although pairs of front and rear engaging portions are provided in the above foregoing embodiments, the present invention is not limited thereto and the engaging portions may be provided at only one of the front and rear sides.

(2) Although the folded portions are folded toward the same sides as the solder portions project in the above foregoing embodiment, the present invention is not limited thereto and the folded portions may be folded toward a side opposite to the solder portions although this results in a slight increase in the thickness of the entire fixing brackets.

(3) Although the engaging portions are folded at the projecting end positions thereof in the above foregoing embodiments, the present invention is not limited thereto and it does not matter how the engaging portions are folded provided that the areas of the engaging surfaces increase in the thickness direction of the engaging portions. For example, the engaging portions may be folded in such a zigzag manner as to alternately arrange peaks and troughs along their projecting directions.

LIST OF REFERENCE NUMERALS

[0065]

K ... circuit board (electric or electronic device)
1 ... circuit board connector
10 ... housing

12 ... mount groove
12A ... back surface of the mount groove (side surface of the housing)
14 ... restricting surface
20, 32, 42, 52 ... fixing bracket (fixing member)
22 ... solder portion
24, 30, 40, 50 ... engaging portion
24B, 30B, 40B, 50B ... folded portion (bent part)
25 ... engaging surface (bottom end of the engaging portion)

Claims

1. A connector (1) to be connected to a device such as a circuit board (K), comprising:
 - a housing (10) with which a mating connector is connectable,
 - at least one fixing member (20; 32; 42; 52) made of a metallic plate material, at least partly mountable into at least one respective mount groove (12) formed in the housing (10), and having a bottom end portion to be fixed to a device such as a circuit board (K),
 - at least one engaging portion (24; 30; 40; 50) formed on the fixing member (20; 32; 42; 52), and
 - at least one restricting surface (14) provided in the mount groove (12) and adapted to restrict a displacement in an insertion direction (ID) of the engaging portion (24; 30; 40; 50) by coming into contact with the bottom end (25) of the engaging portion (24; 30; 40; 50) along the insertion direction (ID),
 wherein the engaging portion (24; 30; 40; 50) is so bent or folded as to increase the area at least of the bottom end (25) thereof in the thickness direction (TD) thereof.
2. A connector (1) according to claim 1, wherein the at least one respective mount groove (12) is formed in a side surface (12A) of the housing (10) such that the plate surface thereof extends substantially along the side surface (12A) of the housing (10).
3. A connector (1) according to one or more of the preceding claims, wherein at least one engaging portion (24; 30; 40; 50) formed on the fixing member (20; 32; 42; 52) and having a plate surface projecting along the side surface (12A) of the housing (10) at least from one of the front and rear edges of the fixing member (20; 32; 42; 52).
4. A connector (1) according to one or more of the preceding claims, wherein at least one solder portion (22) projecting in a direction at an angle different

from 0° or 180°, preferably substantially normal to the side surface (12A) of the housing (10) is provided at the bottom end of the fixing member (20; 32; 42; 52).

5. A circuit connector (1) according to claim 4, wherein the fixing member (20; 32; 42; 52) is fixed to the device (K) preferably by soldering or welding the solder portion (22) to the outer surface of the device (K).
6. A circuit connector (1) according to one or more of the preceding claims, wherein the engaging portion (24; 30; 40; 50) is bent at a projecting end position thereof toward a projecting side of the fixing member (20; 32; 42; 52), preferably of the solder portion (22), with at least one bent part (24B; 30B; 40B; 50B) thereof located more inward than the position of the projecting end of the fixing member (20; 32; 42; 52), preferably of the solder portion (22).
7. A connector (1) according to one or more of the preceding claims, wherein the engaging portion (24) is folded back such that two parts substantially are in surface contact with each other.
8. A connector (1) according to one or more of the preceding claims, wherein the engaging portion (30; 40; 50) is bent so as to be substantially L-, V or U-shaped.
9. A connector (1) according to one or more of the preceding claims, wherein at least one part arranged deeper in the inserting direction (ID) as the restricting surface (14) serve as at least one narrowing portion (15) for narrowing the width of the respective mount grooves (12) preferably in forward and backward directions (FBD).
10. A circuit connector (1) according to claim 9, wherein when the fixing bracket (20) is at least partly inserted into the mount grooves (12), one or more retaining portions (23) of the fixing bracket (20) gradually bite in the narrowing portions (15) and the fixing bracket (20) is held retained in the housing (10).

Amended claims in accordance with Rule 137(2) EPC.

1. A connector (1) to be connected to a device such as a circuit board (K), comprising:

a housing (10) with which a mating connector is connectable,
at least one fixing member (20; 32; 42; 52) made of a metallic plate material, at least partly mountable into at least one respective mount groove (12) formed in the housing (10), and having a bottom end portion to be fixed to a device such

as a circuit board (K),

at least one engaging portion (24; 30; 40; 50) formed on the fixing member (20; 32; 42; 52), and

at least one restricting surface (14) provided in the mount groove (12) and adapted to restrict a displacement in an insertion direction (ID) of the engaging portion (24; 30; 40; 50) by coming into contact with a bottom end (25) of the engaging portion (24; 30; 40; 50) along the insertion direction (ID), **characterized in that** the engaging portion (24; 30; 40; 50) is so bent or folded as to increase the area at least of the bottom end (25) thereof in the thickness direction (TD) thereof, such that the contact area of the engaging portion (24; 30; 40; 50) and the restricting surface (14) is increased by this.

2. A connector (1) according to claim 1, wherein the at least one respective mount groove (12) is formed in a side surface (12A) of the housing (10) such that the plate surface thereof extends substantially along the side surface (12A) of the housing (10).

3. A connector (1) according to one or more of the preceding claims, wherein at least one engaging portion (24; 30; 40; 50) formed on the fixing member (20; 32; 42; 52) has a plate surface projecting along a side surface (12A) of the housing (10) at least from one of the front and rear edges of the fixing member (20; 32; 42; 52).

4. A connector (1) according to one or more of the preceding claims, wherein at least one solder portion (22) projecting in a direction at an angle different from 0° or 180°, preferably substantially normal to a side surface (12A) of the housing (10) is provided at the bottom end of the fixing member (20; 32; 42; 52).

5. A connector (1) according to claim 4, wherein the fixing member (20; 32; 42; 52) is fixed to the device (K) preferably by soldering or welding the solder portion (22) to the outer surface of the device (K).

6. A connector (1) according to one or more of the preceding claims, wherein the engaging portion (24; 30; 40; 50) is bent at a projecting end position thereof toward a projecting side of the fixing member (20; 32; 42; 52), with at least one bent part (24B; 30B; 40B; 50B) thereof located more inward than the position of the projecting end of the fixing member (20; 32; 42; 52).

7. A connector (1) according to any one of claims 1 to 5, wherein the engaging portion (24; 30; 40; 50) is bent at a projecting end position thereof toward a projecting side of the solder portion (22), with at least one bent part (24B; 30B; 40B; 50B) thereof located

more inward than the position of the projecting end of the solder portion (22).

8. A connector (1) according to one or more of the preceding claims, wherein the engaging portion (24) is folded back such that two parts substantially are in surface contact with each other. 5

9. A connector (1) according to one or more of the preceding claims, wherein the engaging portion (30; 40; 50) is bent so as to be substantially L-, V or U-shaped. 10

10. A connector (1) according to one or more of the preceding claims, wherein at least one part of the mount groove (12), which is arranged deeper in the inserting direction (ID) as the restricting surface (14), serves as at least one narrowing portion (15) for narrowing the width of the respective mount grooves (12) preferably in forward and backward directions (FBD). 15 20

11. A circuit connector (1) according to claim 9, wherein when the fixing bracket (20) is at least partly inserted into the mount grooves (12), one or more retaining portions (23) of the fixing bracket (20) gradually bite in the narrowing portions (15) and the fixing bracket (20) is held retained in the housing (10). 25

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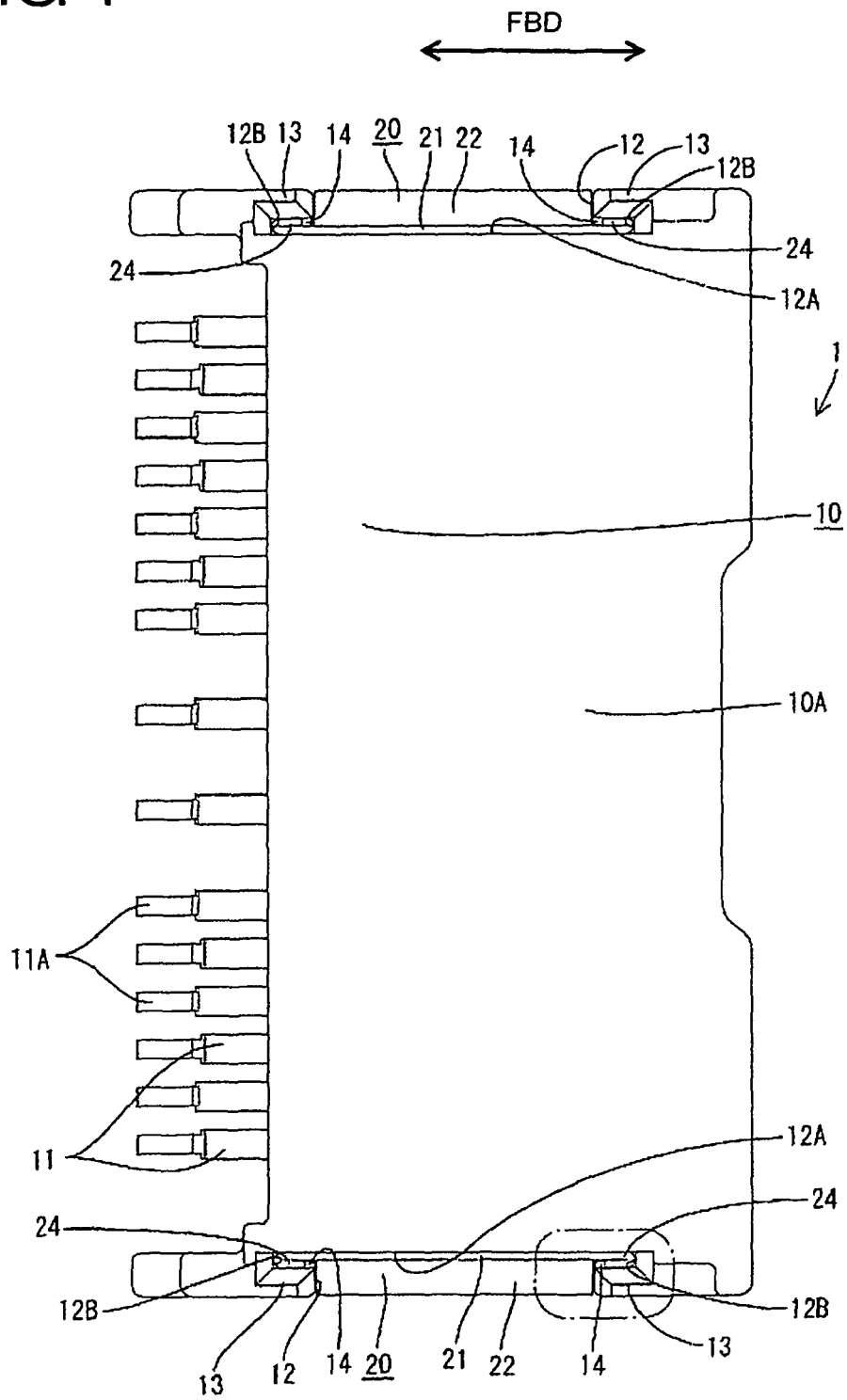
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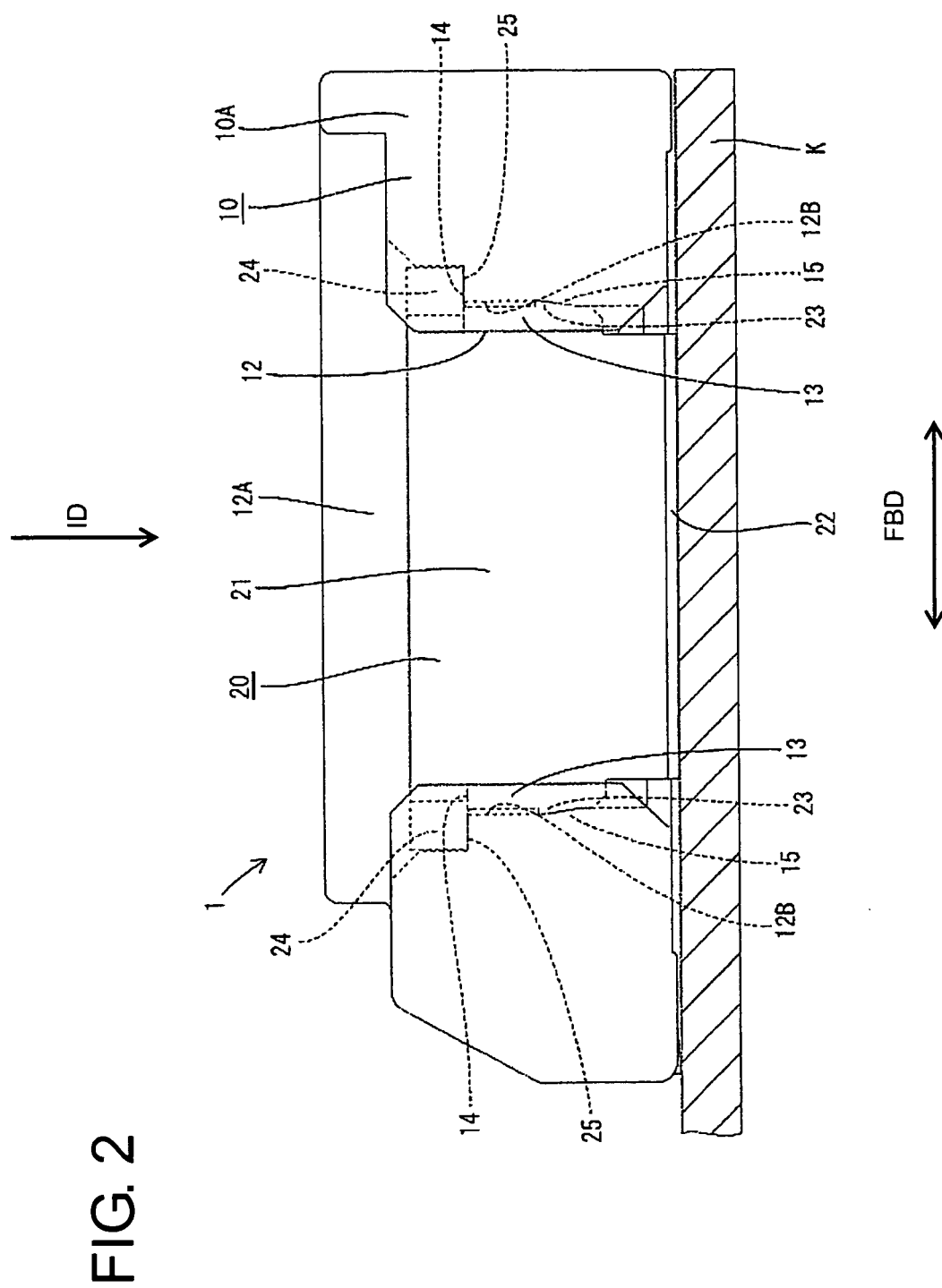
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FIG. 1





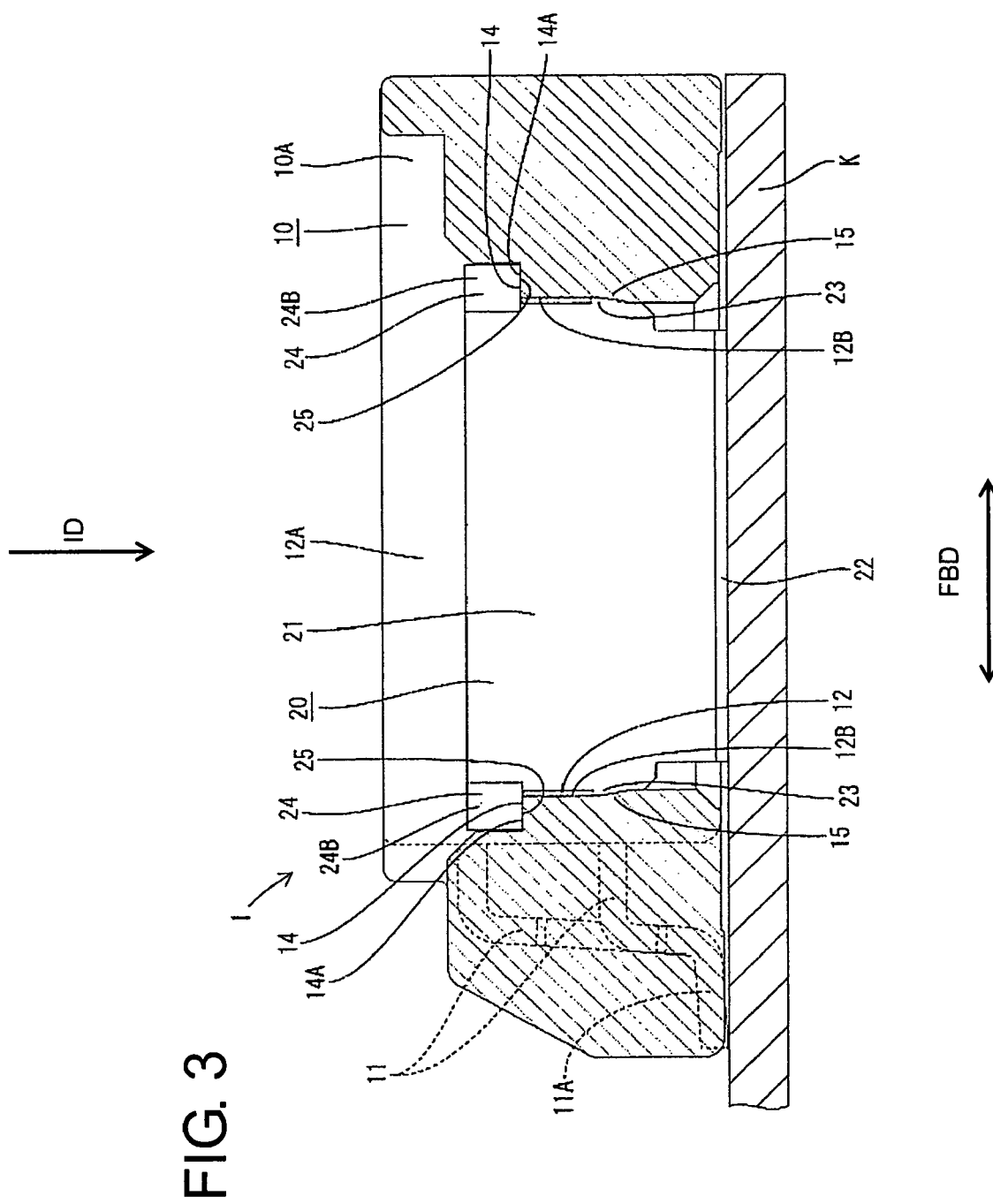


FIG. 4

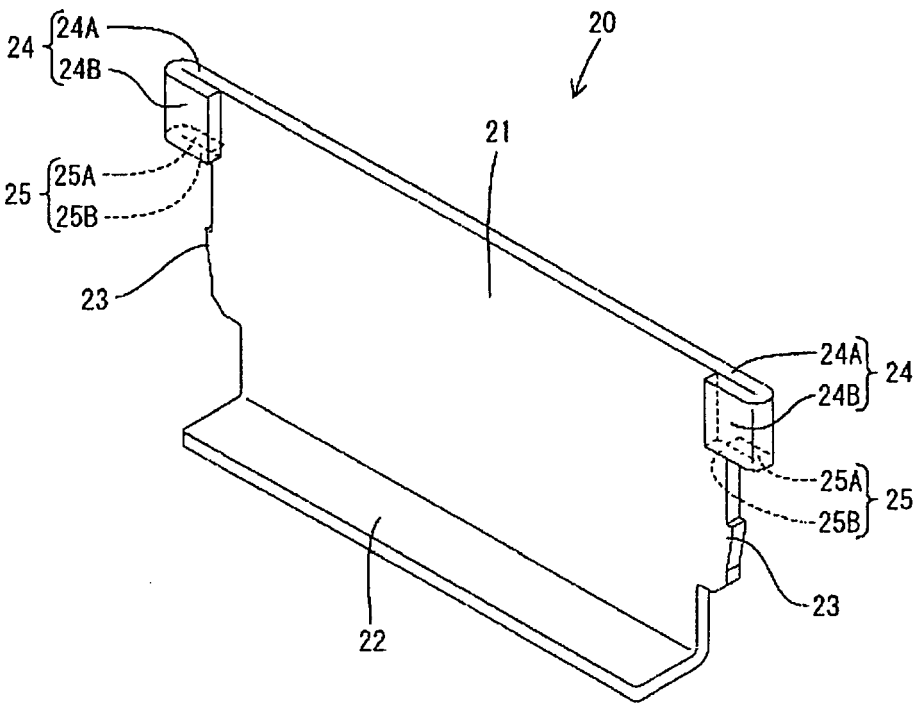


FIG. 5A

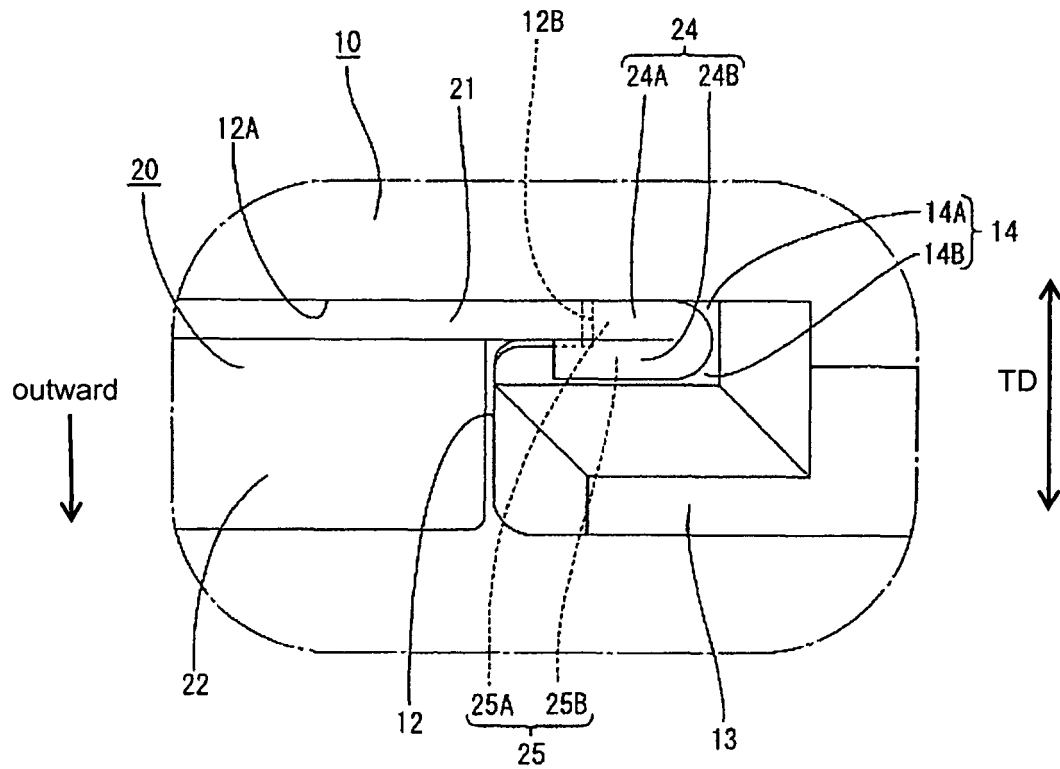


FIG. 5B

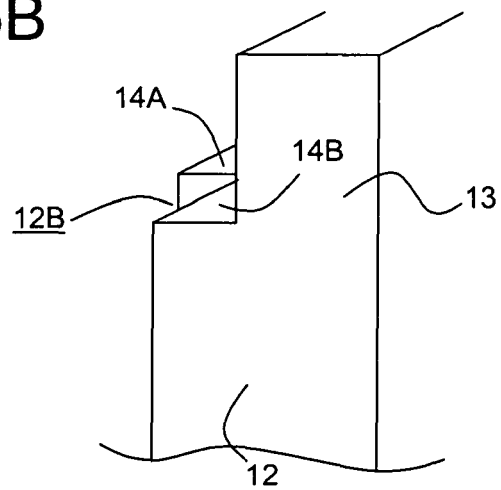


FIG. 6

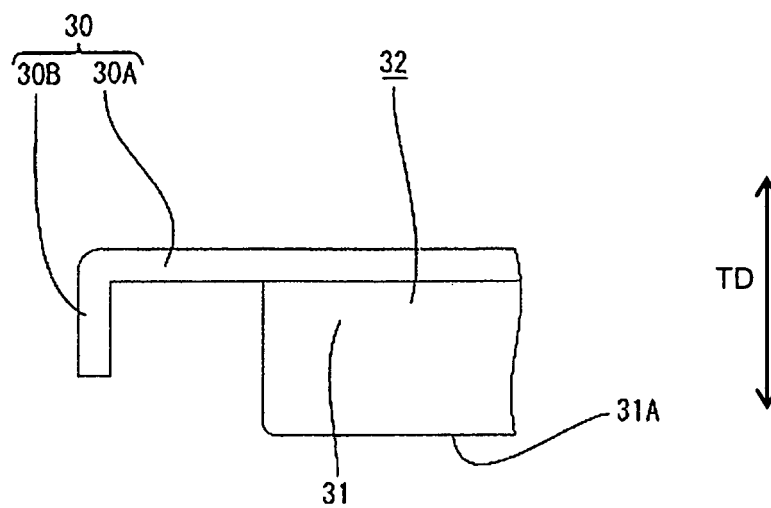


FIG. 7

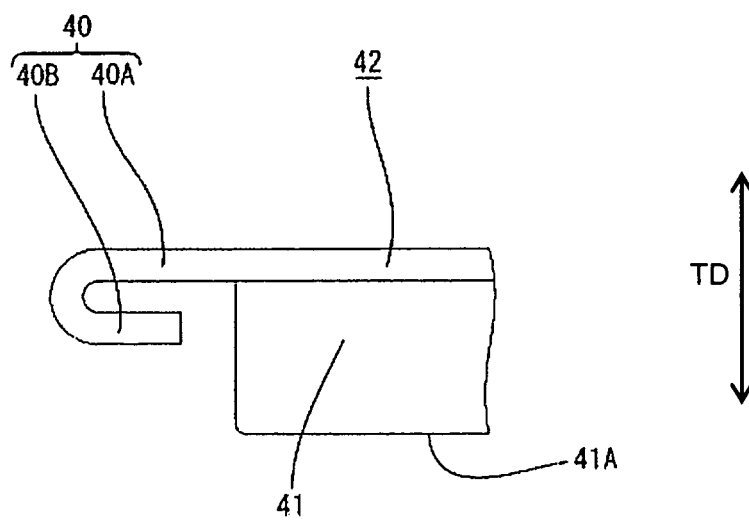
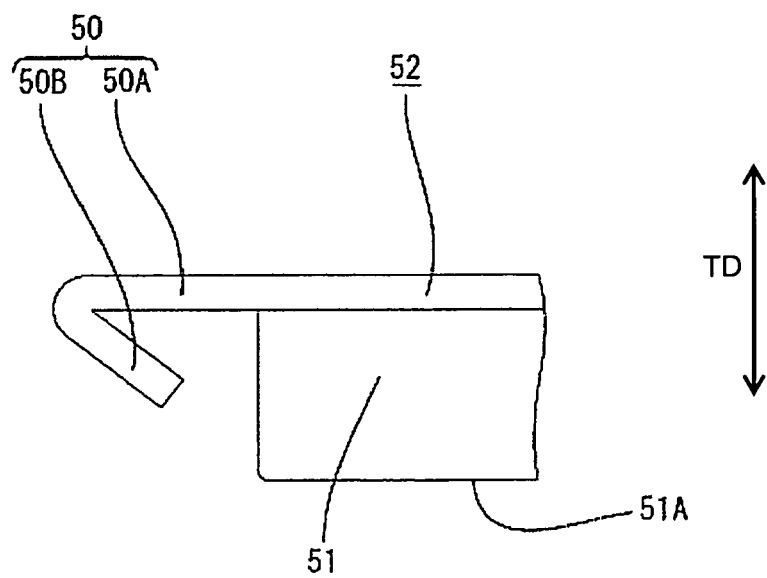


FIG. 8





European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 07 01 6771

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Place of search Munich		Date of completion of the search 12 November 2007	Examiner Chelbosu, Liviu
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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